



ON THE
P O I S O N
O F
C O P P E R.





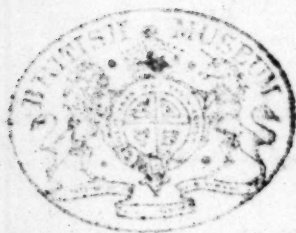
OBSERVATIONS
AND
EXPERIMENTS
ON THE
POISON OF COPPER.

BY
WILLIAM FALCONER, M.D. F.R.S.

*Neque interesse an initio pleraque explorata sint, si a consilio
tamen cæperunt.*

CELSUS.

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T O

DR. DELACOUR.

DEAR SIR,

I EMBRACE with great pleasure this opportunity, however slight, of expressing my esteem and gratitude. I am satisfied a dedication of

A 3 this

DEDICATION.

this kind can add nothing to your reputation ; but at the same time know, you are never better pleased than in patronizing even an attempt towards improvement. How far the ensuing pages may merit approbation, you are the best judge ; but if they meet with yours, I shall esteem it the happiest presage
of

DEDICATION.

vii

of their being likely to gain
that of the public.

I AM,

DEAR SIR,

Your most obliged,

and faithful,

BATH,
March, 1774.

WILLIAM FALCONER.

DEBENTURES

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of the

of the

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OBSERVATIONS
AND
EXPERIMENTS
ON THE
POISON OF COPPER.

THE world is highly indebted to Dr. Baker, and Dr. Percival, for their ingenious and learned dissertations on the poison of Lead; which have doubtless contributed greatly to guard against the pernicious

ON THE POISON

ous effects of that metal for the future. Yet another poison of the metallic kind, nearly, if not altogether, as dangerous as that just mentioned, remains to be noticed; I mean that of Copper. I would not here be understood to say that its ill effects have not been before observed, as I am very sensible they have been long known, and several treatises wrote concerning them in particular cases and circumstances, but no work on the subject in general, at least in our language, has as yet come to my hands.

As the consequences which arise to our health from this metal, are equally

ly hazardous with those that proceed from Lead, and as it is full as liable to gain admission into the body, from its more frequent use for domestic purposes, especially the preparation of our food, and its being easier dissolved or corroded; an account of these, with some remarks and cautions on the best means of avoiding them, will not, I trust, be less interesting to the public.

COPPER is in the most general use of any metal, iron excepted. It possesses many valuable properties, having a great degree of hardness and ductility at the same time, and is neither so apt to rust in the air, or calcine

ON THE POISON

calcine in the fire as iron, which renders it more proper for several purposes than that metal, especially where a moderate degree of heat is employed. On these accounts Copper is in great use in the mechanic arts, for the making domestic utensils, ornaments, mathematical instruments, &c. for which it is admirably adapted. But its greatest consumption, and what principally regards the present subject, is in the formation of vessels for culinary purposes; or at least such, as though they may not absolutely come under that denomination, are employed for the preparation of substances used in diet

diet or medicine, as brewing, distilling, &c.

COPPER is likewise the basis of several compound metals for uses of a similar kind with the foregoing; as brass, bell metal, princes metal, bath metal, white copper, &c. in all of which Copper is by much the largest ingredient, and indeed may be considered as little different from Copper in the effects they are likely to produce; yet this metal, though endued with so many serviceable qualities, is known to be capable of being converted by various means, several of which occur frequently, and almost necessarily, in the purposes

ON THE POISON

ses for which it is employed, of the kind before mentioned, into a noxious substance, the more dangerous, as being, like that of lead, for the most part gradually introduced, and the afflicted person generally without suspicion of the cause of his disorder, and consequently not likely to use the proper means of relief, by avoiding the circumstances that gave rise to it. And I make no doubt that the poison of Copper, as well as that of Lead, is productive of several disorders whose source is either unknown or ascribed to a mistaken origin.

Copper
how rendered ac-
tive.

COPPER, in its metallic state, is, like other metals, generally thought to

to be inactive, as to its effects on the body. Yet of this I have some doubt, since by moderate friction with the hand, which can scarce be supposed to alter it in that respect, as not generating a sufficient degree of heat, it can be made to produce a considerable odour, which seems to indicate that it is by these means capable of being brought into an active state. But whatever doubts we may entertain concerning its activity in this form, we can have none of it when reduced into a saline state, as experience too plainly testifies.

If active
in a me-
tallic
State.

It is dissolved or rendered saline by all the acids. Some writers have de-
nied

Render-
ed so by
Acids.

By the
Vitriolic
Acid,

nied this power to the vitriolic, except when concentrated and assisted by heat, but I find by experience that though its action is slower, yet it will dissolve Copper in considerable quantity, even though the acid be in a dilute state, and no heat used. The solution is of a blue colour, and when evaporated, yields crystals of a blue colour, and rhomboidal figure, which are the common blue vitriol

By the
Nitrous
Acid,

of the shops. The nitrous acid dissolves it very readily and plentifully. The solution is at first green, but becomes afterwards of a sky-blue

By the
Muriatic
Acid,

colour. The muriatic acid does not dissolve it so quickly or so largely as the nitrous, but more so than the vitriolic

vitriolic. The solution is of a brown colour at first, but on standing becomes green. The vegetable acid, By the Vegetable Acid. though its action be slow, yet it dissolves Copper in largest quantity of any of the acids, the nitrous excepted. The solution shoots into bluish green crystals, which are the verdgris of our shops. Alkaline salts, By Alkalies. both fixed and volatile, dissolve it; the former in greater quantity, but the latter more expeditiously. It is By Neutral Salts likewise corroded or dissolved by all the neutral salts, and with most of them forms a bluish green solution or rust.

B

Ex-

ON THE POISON

EXPRESSED oils, according to
 By Oils. Neumann, dissolve it; but of this I
 have some doubt, if the oil is fresh,
 and the Copper in its metallic state:
 but if the oil be rancid, a volatile
 alkali is generated, which acts power-
 fully on the Copper; and if the lat-
 ter be in a state of calx, the oil, al-
 though fresh, will then unite with it
 very easily. Essential oils, especially
 of the more acrid and volatile kind,
 I have observed corrode it very pow-
 erfully.

By Sul-
 phur.

PURE sulphur * does not affect
 Copper, as far as I can find, unless
 assisted

* I PUT a drachm of washed flowers of sulphur
 into a vial with $\frac{3}{11}$ of distilled water, and a thin
 piece

assisted by heat ; but in the state in which we generally get sulphur, when it is scarce ever free from a portion of superabundant acid, there is no question that then it will corrode or dissolve the metal. Hepar sulphuris, with an alkaline salt, dissolves Copper, or at least corrodes it ; as I found a piece of bright Copper, that had lain about a week in a solution of hepar sulphuris in water, much dissolved, and in some places

By Hepar
Sulphur-
is with
an Al-
kali.

B 2

blue,

piece of bright Copper weighing exactly thirty-three grains, and suffered them to stand five days exposed to the air. I then filtered off part of the water, which had no taste of Copper, nor discovered any blue colour on addition of the common spirit of sal ammoniac, or that with quick-lime, nor was the Copper discoloured or diminished in weight,

ON THE POISON

By Hepar
Sulphur-
is with
Quick-
lime.

blue, but I could not discover that it had imparted any sensible impregnation to the liquor. Hepar sulphuris with quick-lime corrodes Copper, but very slowly and imperfectly. A thin plate of Copper had got a few small bluish spots, by lying five days in a very strong solution of this kind; but a weak solution did not affect it, after lying three weeks in it. I could not discover that it imparted, in either case, any cupreous impregnation to the liquor itself.

By
Ardent
Spirits,

ARDENT spirits, when perfectly pure, do not, I believe, affect Copper; but we generally get them, when weak, with a portion of acid adhering

OF COPPER.

21

adhering to them ; and when strong, often with an * alkaline impregnation : in either of which states, they will dissolve or corrode the Copper.

SIMPLE earthy † substances do not, ^{By} Earths,
as far as I can find by experiment,
act upon Copper ; but this is by no
means the case with those saline sub-
stances
B 3

* FIRST alkaline salts are used in the rectification of vinous spirits to absorb the watery moisture. If great care be not taken, some particles of the alkaline salt will be carried over in distillation ; when this happens, as is frequently the case, it gives what the workmen call an urinous relish. I kept a piece of Copper in some pure rectified spirits a week, without its being affected in the least.

† I KEPT a piece of bright Copper five days in strong lime-water, which did not affect it.

ON THE POISON

By
earthy
Salts,

stances which have an earth for their basis, as alum, sal catharticus amarus, and selenites, which all corrode, or dissolve this metal: the first mentioned in greatest proportion, probably as containing an unneutralized acid, which is the case with alum; sal catharticus amarus is the next in strength, and selenites the weakest; but this last, though its action is slow, will nevertheless corrode it in considerable quantity, if suffered to stand any long time. The power these have of this kind is much increased by heat.

By
Water.

WATER is generally thought to dissolve Copper. That common water

OF COPPER.

23

ter gains an impregnation of this kind, by standing in Copper vessels, is well known, by the taste it acquires ; which is, I believe, one of the nicest tests we are acquainted with, when the subject possesses no strong taste of its own, by which this is overpowered. But I suspect that water acquires this impregnation, either from some saline quality inherent in it, or else that the vessel itself had been corroded before, and part of the Copper thus changed into a saline state, and soluble in water. I have kept a piece of bright Copper several weeks in distilled water, without its imparting any sensible impregnation to it, discoverable either

B 4

by

ON THE POISON

by the taste, or by addition of the volatile alkali, which is generally accounted one of the nicest tests of the presence of this metal; and the Copper was even less discoloured, than another piece that had been exposed to the air for the same time.

By Air.

THE air likewise appears to have a power of reducing this metal into a saline state, as it is well known that Copper vessels, if not frequently cleaned, will contract a blue or green rust on their surface. Whether the air itself has any power of this kind, or whether it acts by means of any saline quality adhering to, or united with it, I shall not determine. I have

have twice examined with a microscope the rust of Copper contracted in this manner; in both of which trials, from its pale colour and rhomboidal crystals, I imagined it to be blue vitriol. If this conjecture be true, it will afford a great presumption of the universal presence of the vitriolic acid in the atmosphere, which has been the opinion of many philosophers. But the quantity was too small for me to determine with certainty concerning the nature of the saline substance thus formed. But even granting it to be formed in the above-mentioned manner, it would not follow from thence, that every rust, which Copper appears to
con-

contract spontaneously, is of this kind; since it must vary according to circumstances, especially as the places where vessels of this kind are generally deposited, are exposed to steams and effluvia of various kinds, from vegetable and animal substances, different kinds of fuel, &c. which render it probable, that the volatile alkali, among other things, is often the corroding body.

By Fixt
Air.

FIXT air does not appear, by any experiments I can make, to act on Copper in the least; nay, in some cases, it seemed to protect the metal from the action of the common air. I have kept Copper three weeks in a vessel

vessel of water strongly impregnated with fixible air, without affecting the metal in the least, either in colour or weight, that I could discover; nor did the water give the least signs of its containing Copper.

COPPER received into the body in a saline state, or rendered so by the animal fluids, exerts very violent effects on the system, as a virulent emetic and cathartic, if taken into the stomach in considerable quantity, or dissolved by an irritating menstruum. If it occasions no great evacuation, it frequently affects the nervous system, producing * convulsions,

Effects
of Cop-
per on
the Body.

* Vide Medical Observations and Inquiries, Vol. II.
p. 146.

ON THE POISON

sions, delirium, stupor, and head-ach, and sometimes a high degree of mania, with symptoms of an inflammation of the brain or its membranes. If the quantity taken in be large, it sometimes excites very violent pains; and if the substance be not quickly discharged, inflammation of the stomach and bowels, and death itself.

* Neumann mentions a case from his own knowledge, of a person who, from accidentally swallowing a brass sleeve-button, was seized with the most violent symptoms, and died in the utmost misery. The same author likewise relates from his own authority,

* Vide Neumann's Chemistry, by Dr. Lewis, p. 67.

riety, that vehement vomitings, and even convulsions in children, have been produced by the unguentum *Ægyptiacum*, whose basis is *verdegris* applied to ulcers in the mouth, and accidentally swallowed. I think likewise that there is reason to suspect Copper of some qualities of the narcotic kind, similar to those of Lead. I have been informed that Copper in solution, applied to the ischiadic nerve of a frog, at first excited convulsions, but when these had ceased the limb became paralytic. This quality is by no means inconsistent with its stimulant property, as many substances of a similar effect prove on their first application stimulant, which

ON THE POISON

which perhaps may be an effort of nature to throw off that which would destroy her powers. In the Medical Museum, a story is related of a person who lost the use of his hands by cleaning brass wire, which seemed to act by destroying the nervous power, as the internal, or flexor muscles of the hand, remained in a contracted state, as is generally the case in paralytic affections of that member. I imagine it was from this quality that preparations of this metal formerly gained reputation in fevers, in which disorders it was much recommended by Mr. Boyle and others, as calming the violent and inordinate agitations of the system arising from inflam-

inflammation, especially where the nervous system was peculiarly affected, as in febrile delirium. This effect will not be difficult to explain from this quality, since in such cases the same intention is always pursued, though by different means, as bleeding, evacuations, acids, &c. which all tend to diminish the force and action of the nervous system, which is in such cases preternaturally increased. I am likewise inclined to suspect that its use in some nervous disorders of the spasmodic kind, as the epilepsy, &c. is more owing to its diminishing the sensibility of the system, and thus rendering it less liable to be affected by occasional causes, than to its astringent

ON THE POISON

stringent or tonic qualities, enabling the nervous system to resist slight impulses. Several other metals seem possessed of properties of a similar kind when introduced into the human body in large quantity. Lead I have before mentioned as being well known for its pernicious qualities of this sort. Mercury exerts similar effects. Neumann relates that among the workers of the quicksilver mines, a palsy is the first symptom, to which a salivation soon succeeds. It is likewise observed that few of them live more than four years if constantly employed. The gilders and refiners also are affected in the same manner, though not in so great a de-

a degree. I think it highly probable that the efficacy of antimony in many disorders, fevers especially, is owing to a like quality. It is observed to render the pulse slower, and to procure sleep in a very remarkable manner; and though this may sometimes be ascribed to the evacuation it occasions, yet this is not always the case, since I have frequently observed it to act in this manner without producing any sensible evacuation whatever. In the second volume of the Physical Essays, there is a remarkable account of a case wherein it exerted very extraordinary soporific effects.

C

I have

ON THE POISON

I have seen an instance myself of a small dog twice rendered paralytic by a piece of crocus metallorum which was put into the water he drank, to cure him of the mange, being accidentally left in it a long time. On its being taken out the first time, he soon recovered his palsy, and on its being again put into his water he relapsed, and grew better again on its being removed. Dr. Baker ascribes the paralytic affection, to which printers are subject from handling the types when heated before the fire to dry them after washing, to lead; but I suspect antimony as equally liable to the imputation, as being much more volatile than lead, and
more

more likely to become active in a small degree of heat. The printers themselves, as far as I can find, ascribe the above-mentioned disorder to the antimony that enters into the composition of the types. Most of the metallic preparations likewise are found by experience, if long continued, to weaken the tone of the stomach and organs of digestion, which is probably owing to the above-mentioned property, which many of them seem to possess in common with one another, and possibly may be inherent in more of them, if their qualities were more accurately examined. But to return to the subject.

ON THE POISON

COPPER has been thought by some a principal cause of the scurvy, but I cannot find any reason for believing that it has directly any such effect ; though it must be acknowledged, that by weakening the nervous system and organs of digestion, it may consequentially promote it.

THE various menstrua which act upon Copper, do not seem greatly to alter its effects on the human body ; which proves, that the effect is owing to the metal, not to the solvent. The principal point in which they vary, appears to be in their degree of stimulus, or irritating quality. The combination of Copper with the
nitrous

nitrous acid is accounted the most stimulant, next that with the muriatic acid, next that with the vegetable (verdegris), then with the volatile alkali, then the fixt, then with the vitriolic acid (blue vitriol). When united with neutral or earthy salts, it is much more mild, and most so, in all cases, when crystallized. What degree of stimulus the combination of Copper with oily bodies may have, in proportion to those just mentioned, I cannot say, but know from experience its activity is very great, probably owing to the volatile alkali often contained in oil when rancid. The green or blue rust which Copper spontaneously con-

C 3 tracts,

ON THE POISON

tracts, is likewise very stimulant, but in what proportion, relative to the above, I cannot determine.

Copper,
how
most
likely to
gain ad-
mission
into the
body.

HAVING thus briefly given an account of Copper, and of the substances that dissolve or corrode it, and its effects on the human system; I shall now proceed to mention the circumstances in which it is most likely to find admission into the body, or produce deleterious effects upon it, which will suggest some cautions proper to be attended to, in order to avoid them; and I shall in this part follow the order in which I have treated of the substances that dissolve or corrode it.

FIRST

FIRST then of Copper in its metallic form. In this state, we might imagine it not very likely to find admission into the body; but I suspect it occurs oftener than is apprehended. Halfpence and farthings are frequently given to children to play with, and as they generally put their toys into their mouths, they are often swallowed, or part of the Copper abraded by their teeth. The last of the above circumstances is applicable to all toys whatever, for young children, made of brass or Copper, or other mixt metals wherein Copper makes a part of the composition. I likewise believe, that sometimes Copper in this form gains admission into

In its
metallic
state.

ON THE POISON

our food, by the scraping of the bottoms of brass or Copper pans, &c. especially when they contain some viscid substance, as sweetmeats, or some other food dressed with thick sauces. The like may happen from some of the coarser kind of spoons made of a mixt metal called ockamy, (corruptly for alchemy) which is a coarse kind of brass. These are in frequent use among servants and the lower kind of people, and I have often seen them greatly diminished in their substance by use. The dangerous custom of many, of putting pins into their mouths, deserves to be particularly noticed, as it is generally imagined all the danger lies in
its

its mechanical action if swallowed; but by the afore-mentioned account of its effects, it appears to be likely to produce disagreeable consequences by its specific action as a metal.

THE exhalation from Copper strongly heated, is said by some writers to be injurious to the lungs, and occasion coughs. Ramazzini mentions that the artificers in this metal are subject to the above complaint, and to vertigo and a discoloured complexion, owing probably to the particles of Copper either exhaled by heat, or rubbed off in the working, floating in the air and taken in by inspiration. In proof of this
he

ON THE POISON

he observes that the beard and hair of the workmen in time become green, owing probably to the particles of Copper lodged upon the body being corroded by the perspiration.

As to the effects of Copper externally applied, I have before mentioned that it emits, even on slight rubbing, a foetid odour, and seems, in part at least, volatilized, by which we might imagine it would be rendered active. But I cannot discover any effects ever produced by it in this way, among those who are most conversant in handling and rubbing this metal, provided there be no
fusp-

suspicion of any being taken into the body. But the opportunities which this metal has of getting into the body in a state of solution, are much more numerous. The first menstruum that occurs in the order above-mentioned, is the vitriolic acid.

As
dissolved

At first view we might imagine that Copper would be very little likely to gain admission into the body in combination with any of the mineral acids, as they are seldom met with, and cautiously avoided under suspicion of their poisonous qualities. But on a more minute enquiry we shall find that this is not so

By the
Vitriolic
Acid.

ON THE POISON

so unlikely to happen as might perhaps be apprehended. Several springs are found to be impregnated with the vitriolic acid in its separate state, the water of which, if used with Copper or Brass vessels, may corrode them, and thereby gain from them a cupreous impregnation, the same as if a portion of blue vitriol was dissolved in the water. The vitriolic acid indeed, when dilute, acts very slowly upon Copper, so as scarce to affect it of a long time; but in this case it is generally in some degree in a volatile state, in which it corrodes metals more plentifully, and also assisted by heat, which greatly increases the attraction between this acid
and

and Copper. But to put this out of dispute, I made the following experiment.

I took two sauce-pans, one Brass, and the other Copper, both perfectly clean. Into each of these I put two drops of spirit of vitriol, and a pint of distilled water, and set them both on the fire, and kept them boiling about twenty minutes: I then removed them from the fire, and set them to cool. When cold, they had each acquired a coppery taste, and struck a faint blue with spirit. salis ammoniaci commun.

ON this account, great caution
should

ON THE POISON

should be had in the use of Copper vessels by those who inhabit a country where mines, of coal especially, are frequent, as the springs in such situations are frequently impregnated with this acid.

WATERS also containing alum, which by Dr. Percival's experiments appears to be far from an uncommon impregnation, may acquire a taint of a similar kind from Copper vessels. That ingenious writer has, in a late essay, very judiciously pointed out the danger of water of this kind acquiring an impregnation of lead, from passing through pipes of that metal; as he represents with great justice,

justice, that it is but reasonable to suppose that the vitriolic acid, which is the basis of alum, would quit it to unite with the lead, to which it is known to bear a stronger attraction. If this conjecture be probable, as to lead, it holds much stronger of Copper, whose affinity with the vitriolic acid is much greater than that of lead, and is more liable to be increased by exposure to heat, which I have before observed increases the dissolving powers of the acid upon Copper very considerably. But tho' I doubt not that the alum is decomposed in the manner above-mentioned, there is no necessity to suppose it, in order to account for its action
upon

ON THE POISON

upon Copper; since alum has always a portion of superabundant acid adhering to it, which would undoubtedly, when assisted by heat, act upon the metal. And in confirmation of this, I find by experiment, that a solution of alum in water will, when assisted by heat, dissolve Copper without causing any precipitation of earth, which would have been the case, had a decomposition of the alum taken place.

NOR are chalybeate waters of every kind safe to be trusted in Copper vessels. Those, where fixt air is the menstruum for the iron, do not affect Copper. But this is not always

ways the case, since several waters of this kind contain iron, as united with the vitriolic acid in form of green vitriol. Now though the attraction of iron to the vitriolic acid be generally esteemed stronger than that of Copper, yet this holds only of it when heat is not applied; for if that be used, the vitriolic acid will leave the iron*, and unite with the Copper. The frequency of chalybeate springs in England makes them in many places, especially the country, be used for domestic purposes; but we should be cautious how we em-

D ploy

* THIS fact is noted by Dr. Lewis, New Dispensatory, edition the 2d, p. 497.

ON THE POISON

ploy them in our culinary operations, where heat is necessary, along with copper vessels, since by this means we may, as appears by the above circumstance, communicate a dangerous quality to our food, if the chalybeate impregnation be of the acid kind.

As the vitriolic acid is frequently advised for the sick under various forms, and as the medicines are frequently (I believe too often) heated before they are administered, we should be very cautious of using Copper vessels for such use, which would certainly, when heat is employed, impart an impregnation of
this

this kind to the liquor, which in such cases might be especially dangerous.

NOR is it at all improbable, that a solution of this metal in the nitrous acid sometimes finds admission into our food. The nitrous acid indeed is generally thought not to be (properly speaking) a native impregnation of springs, but at the same time it must be allowed, that it frequently finds admission into the water commonly used for dressing our victuals. There is great reason to think that it is produced under certain circumstances by putrefaction; and what greatly confirms this hypothesis

By the
Nitrous
Acid.

D 2

is,

ON THE POISON

is, that it is often found plentifully impregnating the spring waters in great cities, many of which are tainted with some putrid animal or vegetable matter. Dr. Heberden found this acid in the London pump-water in double at least, and sometimes in triple, the proportion of either of the other two mineral acids, viz. the muriatic and vitriolic, which still were both in quantity sufficient to be discovered by chemical analysis. The danger of using Copper vessels with such water will be very obvious, when we consider that this acid dissolves Copper the most expeditiously and plentifully of any, and that the solution of it in this acid
is

is the most acrid and stimulant of any with which we are acquainted. The caution before given relative to the danger of using Copper vessels in the warming of medicines, hold at least equally strong with respect to the nitrous as the vitriolic acid.

THE same learned writer, whose authority we have no reason to doubt, mentions his having discovered the muriatic acid in springs under similar circumstances. This, though its action be not so quick as that of the nitrous acid, strongly adheres to the metal, and forms with it a compound equally noxious. The same caution then is requisite where the presence

By the
Muriatic
Acid.

D 3 of

ON THE POISON

of this acid is suspected as the foregoing, both in diet and medicine.

THE above cautions with respect to the mineral acids will not, I trust, be deemed impertinent or unnecessary, when we consider that pump water is so much used in great cities, London especially, for dressing our food, in which Copper vessels are generally employed. The prevalence of the nitrous acid in the pump water of London is so great as to discover itself to the taste, and turns meat red that is boiled in it. Tea likewise is, I believe, generally made with spring water among the lower kinds of people, from a notion of its
extracting

extracting the qualities of the tea more powerfully, which they imagine from the infusion being generally of a darker colour, which is owing to the effect of the fossil ingredients in the water, and not to the qualities of the tea itself being more fully extracted. If we consider how frequently this beverage is used by all ranks, that the tea-kettles are generally made of Copper, and often without tinning, and with their mouths so narrow as to be with difficulty cleaned on the inside, and that the spring water often used for making tea, especially in great towns, London particularly, is impregnated with

ON THE POISON

many substances capable of dissolving it, * and that this power is greatly assisted by a boiling heat, which is for the most part long continued, it will not seem improbable that Copper may be introduced unsuspected in this manner, and that some of the effects usually attributed to tea may sometimes be in part owing to this cause. And this opinion is the
more

* THIS observation of Copper being likely to be introduced into our bodies by being dissolved by the saline qualities of the water used for making tea, is not confined to acid impregnations only, but extends equally to alkaline ones, both fixed and volatile, to common salt, glaubers salt, hepar sulphuris with an alkaline salt, sal catharticus amarus, and alum, with each of which the water used for this purpose is frequently impregnated.

more probable, as the same effects are produced by both of them, such as cholicky complaints, nausea, tremors, and paralytic disorders, which might easily cause the effect of the metal itself to be overlooked.

NOR are silver vessels, as Neumann observes, though less objectionable, entirely to be depended upon, where the presence of these acids is suspected. Silver is always alloyed with Copper to give it a proper degree of hardness. The English standard is $12 \frac{3}{4}$ of Silver to 1 of Copper. The Copper in this proportion is defended from the action of several menstrua, which act upon it in its
separate

ON THE POISON

separate state; but acids will still affect it. I have seen blue spots on the sides and bottom of a silver vessel, from water slightly acidulated with each of the mineral acids being boiled in it, and suffered to stand; and have observed these to be much more numerous in those parts which were soldered, the solder being, as I am informed, more largely alloyed with Copper, in order to render it more easily fusible. This fact might be urged as an additional reason for keeping up the standard of our silver at the present time, as silver vessels are so much more generally used, and we are without suspicion of their imparting any noxious quality, and
on

on that account possibly less attentive to guard against their contracting any rust or corrosion of this kind. I remember to have seen a silver tea-kettle, which had been much used, whose lid in the parts about the rim where the solder was in greatest quantity, turned perfectly blue, which was probably owing to some acid in the water arising in vapour. It is therefore no less proper on account of health, than neatness and delicacy, that all silver plate that is used in our diet be kept perfectly clean, especially if it be highly ornamented, and worked, as such pieces generally have more solder used about them, and moreover,
from

ON THE POISON

from the inequality of their surface more apt to conceal the rust. They ought all, in my opinion, to be made with an opening sufficiently large to easily cleaned on all parts of the inside, which in the present mode is far from being the case with some of the pieces of plate most liable to suspicion in this way, as tea-urns, tea-kettles, &c. I have observed the rust thus contracted to adhere so strongly as not to be got off by mere washing, without actual rubbing.

BUT the form in which Copper most frequently gains admission into the body, is in combination with the vegetable

vegetable acid. This may be here With the Vegetable Acid. considered as of two kinds ; viz. the native, as exhibited to us in the juices of fruits, as prepared by nature ; and that produced by fermentation, as the acid in wine, beer, and vinegar. The action of these upon Copper does not seem specifically to vary greatly, being probably only in proportion to the degree of acidity in each of them. Almost all vegetables possess more or less of an acid quality, and all are capable of being rendered extremely acid by fermentation. As vegetables make so large a part of the daily food of all ranks of people, and as Copper vessels are in a general use for the
prepa-

preparation of them, it is highly necessary to guard against any ill consequences that are likely to ensue from this practice. The greatest part of the common vegetables eaten with flesh meat, possess but a slight degree of acidity. This quality is most prevalent in the fruits, which are not so often made use of in this way; in less degree in the leaves, less still in the roots, which are in the most common use for this purpose of any part of the vegetable, and less still in the seeds. But in order to ascertain the effects which these vegetables would have upon Copper or Brass, by being boiled in vessels

vessels of this kind, I made the following experiment.

I PUT two pieces of cabbage, weighing each about four ounces, one into a Brass, and the other into a Copper sauce-pan, both perfectly clean, with a pint of distilled water to each. After boiling twenty minutes, they were both removed from the fire, and about three ounces of water from each poured off immediately, and set to cool. The water in both had no taste of Copper, nor was either of the pans in the least corroded; nor did any Copper-coloured rust appear on some bright
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iron wire *, which I put into it, after lying twenty-four hours. I tried the same experiment with potatoes, turnips, carrots, onions, rice, and barley, but did not find the water in any of the experiments had gained the least impregnation from either the Brass or Copper vessels.

THE foregoing experiments prove, that Brass or Copper vessels do not impart any sensible impregnation to the

* I FOUND this test succeed better in discovering the presence of Copper, when united with the vegetable acid, than the volatile alkali, since that has the property of changing the herbaceous juices of plants to a green colour, which obscured the blue one caused by the Copper.

the above vegetables, merely by their being boiled in them ; and we may conclude from analogy, that the same would be the case with several of the others commonly used, such as spinach, lettuce, celeri, cucumbers, pease, beans, French beans, parsnips, and beet, which do not appear to have any greater dissolvent powers than those already tried. But we should be very cautious of trusting too much to this presumption. If they are suffered to stand in the vessel when cold, they will certainly corrode the Copper ; or if the vessel itself be not perfectly clean, the vegetable juices will dissolve the rust very readily, and thus gain a cupre-

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ON THE POISON

ous impregnation. Great care is likewise necessary, that even the water in which they have been boiled, do not remain in the vessel longer than is absolutely necessary, as that will corrode it, as well as if the vegetables themselves were in it.

ANOTHER method by which Copper united with the vegetable acid has been not without reason suspected of gaining admission into the body, is in the making of syrups, sweetmeats, and preserves, for which Copper vessels are generally used. Fruits either entire, or part of them, or their expressed juice, are generally employed for this purpose, to which a
large

large proportion of sugar is added. If the form of the fruit is intended to be preserved, no great heat is necessary, and that but of short continuance, which is likewise the case with syrups; but where any inspissation of the juices is required, a longer duration of heat, and a greater degree is necessary, as in jellies, jams, &c. and a still longer where this inspissation is carried to a great length, as in robs, though in the latter case little and sometimes no sugar is used. From the above account of their mode of preparation, we might imagine that as the vegetable acid is well known to dissolve Copper in great quantity, as some of the most

E 2

acid

acid fruits and juices are frequently made use of, as of lemons, oranges, &c. as sugar itself will act upon Copper, either as containing an acid, which it does, or by its proper qualities, as an essential salt of plants; and as we know, that in most cases the dissolvent power of acids on metals is much increased by heat (which in one case is observed to increase their attraction to Copper particularly, as has been before mentioned with respect to the vitriolic acid) we might perhaps imagine that all preserves thus prepared, the more acid ones especially, must partake, in a great degree, of the noxious qualities of this metal. Yet Dr. Lewis observes,

observes *, “ That the confectioners,
“ who are the most dextrous people
“ at these kind of preparations, to
“ avoid the expence of frequently
“ new tinning their vessels, rarely
“ make use of any other than Cop-
“ per vessels untinned, in the prepa-
“ ration even of the most acid syrups,
“ as of oranges and lemons. Ne-
“ vertheless, by taking due care that
“ their coppers be well scoured, and
“ perfectly clean, and that the syrup
“ remain in them no longer than is
“ absolutely necessary, they avoid
“ giving it any ill taste or quality
“ from the metal.”

* LEWIS'S New Dispensatory, edit. 2d, p. 340.

ON THE POISON

As this circumstance is of great importance to be fully ascertained, the following experiment was made for that purpose.

I PUT about three ounces of lemon juice, with as much sugar as was sufficient to make it into a syrup, into a Copper, and the like quantity into a Brass pan, both perfectly clean, and boiled them both for fifteen minutes over the fire. I then poured off about an ounce of syrup from each. It had acquired no taste of Copper, neither of the pans were in the least corroded, nor did any Copper-coloured rust appear on some bright iron wire, which I put into the

them, and suffered to stay twenty-four hours. I set the pans in a cool place, with the remainder of the syrup in them, until next day, and then examined them a second time. The pan was not apparently corroded, but the syrup had gained in both an evident Coppery taste; and in a few hours, covered some iron wire that was put into it with a Copper-coloured rust.

THE former of the two last experiments might be taken as an instance that sweetmeats gain no impregnation from Copper vessels in the above circumstances, since lemon juice would be the most likely of

any to shew it, on account of its superior acidity. But to make it more satisfactory, I examined several other syrups from sweetmeats that had been carefully prepared by my own direction in the same manner, as of apricots preserved, and syrup from white plums, none of which gave the least mark of containing Copper. But the last experiment proves that we ought to be extremely cautious how we let them stand after they become cold, as they will then soon acquire an impregnation of this kind. Nor are vessels either lined with silver, or even of solid silver, entirely to be trusted without the above precaution, though less dangerous than
Copper-

Copper. I have seen a silver vessel corroded, and turned blue in many places, from having some acid punch left in it some days, which would no doubt have been more affected had the juice of the fruit itself undiluted been left in it.

As lemon juice is frequently used in fauces, the following experiment was tried, to discover what effect it would have upon Copper vessels, when mixed with oily substances and animal juices.

ABOUT four spoonfuls of gravy, two of melted butter, and about two tea-spoonfuls of lemon juice, (which
I am

ON THE POISON

I am informed is a very common fauce) were put into a Brass fauce-pan, and the like quantity into a Copper one, both perfectly clean, and boiled for a few minutes, and poured off. No taste of Copper was perceivable in either of them, nor were either of the pans at all corroded, nor was a piece of bright iron wire turned red by lying twenty-four hours in the fauce, after it was poured off from the vessels.

THIS experiment seems to prove, that we need be under no concern relative to acid fauces gaining any impregnation from Copper vessels, provided they be not suffered to remain

main in them longer than is absolutely necessary, and the vessel itself be kept perfectly clean.

THERE are likewise undoubted proofs of the simple waters employed in medicine frequently acquiring a taint of this kind in distillation.

Impreg-
nation of
Copper
given to
liquors
in distil-
lation.

Dr. Lewis observes, that if the distillation be protracted too long, an acidulous liquor arises, which has sometimes extracted so much from the Copper head of the still, as to prove emetic. This I doubt not is often the case, yet I imagine it sometimes happens from another cause, which I shall mention hereafter. To this are owing, as the
same

same writer observes, the effects of some of these waters in destroying worms in the human body.

Tea, if
noxious,
by an
impreg-
nation of
Copper.

SOME have attributed the pernicious effects of tea on the nervous system to an impregnation of this kind, which it acquires in the course of its preparation. It is commonly imagined, that in order to give tea leaves the curl which* they have when they come to us, they are rubbed with the hand on Copper* plates heated, and from thence acquire an impregnation of this metal; and some have even

* NEUMANN says iron plates are used for this purpose, and I have lately had undoubted authority for the truth of this assertion from other hands,

even attributed the fine colour of the green tea to the same cause. In order to determine if this conjecture was justly founded, I made the following experiments.

I took two drachms of green tea of twenty-one shillings per pound, the like quantity of gunpowder tea, the like quantity of tea of eighteen shillings, of sixteen shillings, and of twelve shillings; and on each of these I poured two ounces of distilled water, and set them to stand in a cool place for twelve hours. I then poured off an ounce of the clear liquor from each into separate glasses, which had acquired in all a beautiful
brown-

brownish green colour, and a strong taste of the tea, but no flavour of Copper in any. Into each of these I put some bright iron wire. After forty-eight hours, the infusions had all acquired a deep black colour, but the wire itself, in all of them, had no Coppery rust on its surface; which certainly would have been the case, had the liquor contained Copper in solution. We may therefore rest assured, that the pernicious effects of tea, however similar to those produced * by Copper, are not owing to

* THAT the narcotic effects of tea may be owing to a quality of the plant itself, has been fully proved in Dr. Lettsom's ingenious treatise on that subject.

to any Copper contained in the tea itself.

FERMENTED liquors likewise (whether from any acid generated in the vinous fermentation, or from part of the liquor having gone on to the acetous, is not certain) are observed to corrode Copper. On this account we should be very cautious relative to the cocks by which wine and beer are drawn off, that they are kept as clean as possible, and not be suffered to remain longer in the wine casks than is necessary for bottling it. This caution is more especially necessary with respect to *made* wines, which are more acedent and imperfectly fermented

Fermented liquors, how liable to be impregnated with Copper.

ON THE POISON

fermented, part of them being generally in the state of must, and part changed into vinegar, and more apt to corrode Copper than the foreign wines. I suspect that an emetic quality, which I have several times observed in made wines, may sometimes be produced by some accident of this kind. For malt liquors which are drank out of the cask, I think the common wooden spigot and faucet much cleaner and safer than brass cocks; and I think some contrivance of the same kind might be found out for wine, which is drank out of the cask; or perhaps some compound metal of tin and bismuth, which

which is not affected by the vegetable acid, might answer very well.

FERMENTED liquors do not affect Copper vessels, if kept in them only while heated, and not suffered to remain in them in the cold; therefore, with proper caution, they might be safely used in sauces with Copper vessels.

As Copper cauldrons, or boilers, are so generally employed in brewing, the preventing any impregnation of this kind being imparted to the liquor, is a point of great public importance. From analogy of what has been said before, we may I think

F

safely

safely conclude, that if due care be taken to keep the Copper perfectly clean, and to let the wort remain in it no longer than is absolutely necessary, and to rinse out the Copper as soon as possible afterwards, no impregnation of this kind is to be feared; but if the Copper be not carefully cleaned before it be used, the wort will infallibly dissolve the rust of it; and if any of the wort, however little, be left in the boiler, it will become acid, and corrode the copper powerfully, and impregnate the liquor that is afterwards put into the vessel with poisonous qualities.

MILK

MILK pans are frequently, though I think improperly, made of Brass or Copper. Every one knows the disposition of milk to become acid, especially in warm weather, when it will scarce stand twelve hours without acquiring this quality in some degree. It is very possible that it may become sufficiently so to act upon the Copper before it be perceivable to our senses. Add to this, the danger of the pans not being kept perfectly clean, or of having any of the milk accidentally left in them, which will, without the greatest care, often happen, and in that case will infallibly corrode the Copper.

ON THE POISON

Vinegar
how lia-
ble to
gain an
Impreg-
nation
of Cop-
per.

ALL the above cautions are applicable, in a greater degree, to vinegar, which corrodes Copper very powerfully, and even quicker than the native acid, in my opinion. I have observed the vapour of vinegar to be remarkably corrosive of this metal, and on this account the distillation of vinegar is a point of great importance to be attended to *. I have frequently found distilled vinegar to have gained an impregnation of Copper, which was probably contracted

* THIS caution is very necessary to be attended to in some pharmaceutical preparations, as in the distilling the aqua alexeteria spirituosa cum aceto, and all others where vinegar is directed to be distilled.

tracted from the head of the still in distillation. Indeed I think no vessels but those of glass are proper for this operation.

THE above-mentioned quality of vinegar should make us very cautious in what vessel it is boiled, as it is frequently done for pickles. The preparation of these is a matter of great consequence, as they are so much used, especially by those of higher rank. The fine blue and green colour, for which several of them are so much valued, has been esteemed by many a presumptive circumstance of their having gained some impregnation of this kind. As

this fact is very material to be ascertained, I made the following experiments in order to determine it.

I took about an ounce of pickle from some cucumbers which were bought at a noted shop, and were remarkable for their colour in a high degree. It had a peculiar taste of the metallic kind, and smelt like the effluvia from Copper that has been strongly rubbed, which was even so powerful as to produce a slight degree of nausea. Into this I put some bright iron wire, which in a short time was covered with a red rust, exactly resembling what iron acquires from a solution of Copper in an acid.

I tried

I tried the same experiment with some pickle of the same kind from cucumbers procured from another place, which were rather inferior in colour, but still shewed some, though less, signs of containing Copper. Pickles, I have observed, which are prepared without any impregnation of this kind, are generally of a faint green, rather inclining to yellow; and I am persuaded that this colour, which is made so greatly a test of their goodness, is always owing to this cause.

It is a well known maxim among house-keepers that pickles will never be green unless a Copper or brass

ON THE POISON

pan be used, and if the desired colour be not obtained thus in sufficient degree, it is common, I am informed, to throw in a few half-pence afterwards, which seldom fails to impart the tinge required. This is very probable when we consider that Copper is more acted on by the vegetable acid in the cold, than when heated. I have examined some books of modern cookery, and find that whenever a green or blue colour * is desired,

* VIDE Art of Cookery made plain and easy, by H. Glasse. London printed, 1770. New edition. Receipts for pickling walnuts green; to pickle gerkins; large cucumbers; french beans; grapes and samphire, p. 260, 262, 264, 267, 270. Vide also the Universal Cook, by John Townsend, printed 1772, and several others.

desired, a brass, bell metal, or Copper pan, is directed to be used. It is not improbable that this often happens when such an adulteration is neither designed nor suspected, from using distilled vinegar which is often employed for these purposes, and is frequently impregnated with Copper from the head of the still. Vinegar likewise dissolves the Copper alloy in silver, and even the vapour that exhales from it when cold will have the same effect. On this account I think I think the tops of vinegar cruets are improperly made of silver, as is now frequently the fashion. I have seen these acquire a thick coat of verdigrease on their inside,

sides, especially when they are made hollow with a narrow opening, so as to be with difficulty cleaned. This objection holds still stronger when the spout itself through which the vinegar is poured is made of silver.

Fixt Al-
kaline
Salts.

Fixt alkaline salts, as they never enter into our food, we might imagine little likely to find admission into the body as united with Copper. I believe indeed that it seldom happens, yet some cautions on this head may still not be unnecessary. Some mineral waters contain the fossile alkali in a pure state, and some of these I know are used for the purpose of dressing food; the consequence
that

that may arise from this when Copper vessels are employed are too obvious to need any explanation. Soap likewise, which always contains an alkaline salt, acts powerfully in corroding Copper. No Copper or brass vessels therefore should have any soap employed in cleaning them, or at least should be carefully washed afterwards with clean water, to clear away all the remains of the alkaline salt that was left in them. Great care ought likewise to be taken that no Copper vessel be employed in making any soap that is to be used internally, and in every other medicinal preparation in which alkaline salts make a part of the composition.

ON THE POISON

on. * It is observable that fixed alkaline salts do not, like acids, affect the Copper contained in silver as alloy. Silver vessels may therefore be safely used in such cases.

Volatile
Alkaline
Salts.

A COMBINATION of Copper with volatile alkaline salts is more to be suspected. The water commonly used in great cities is found to be often impregnated with this salt, owing to the putrefying substances it meets with in its course, which generate it plentifully. Dr. Heberden found

* IT may be proper here to remark, that spirit of wine when highly rectified, often contains an alkaline impregnation. Vide what has been before observed.

found it in considerable quantity in several of the pump-waters in London; and I much suspect, from the quantity of putrefying bodies daily thrown into it, that the Thames water would have given marks of a like quality, had it been examined, as its tendency to ferment and corrupt is so remarkable.

As the volatile alkali is well known to act powerfully on Copper, and as the compound it forms with it is peculiarly acrimonious, we may easily judge of the necessity of avoiding such an impregnation as much as possible. Perhaps the best general direction would be, to let water
of

of this kind stand a day or two exposed to the open air before it is used, in which time this substance would probably be dissipated. But this, I fear, would serve best for spring waters, which had acquired such an impregnation merely by coming in contact with it, and not so well for such waters as had generated it by their own disposition to fermentation. I much suspect that the rust which Copper vessels spontaneously acquire in our kitchens, is mostly of this kind. The steam arising from meat while dressing, from coals falling accidentally among the gravy, the effluvia from meat itself, which is seldom eaten until some part of it has acquired

acquired a putrid disposition, in which, and burning, especially of animal substances, this salt is copiously produced, the smoak of pit coal, which is found to contain a large proportion of volatile alkali, render this opinion very probable.

GREAT care is likewise necessary, that the Brass or Copper vessels used in our kitchens be kept as clean as possible, and the remains of the meat that has been dressed in them, and the water wherein they have been boiled, be removed as soon as may be, since, if suffered to stand, they will soon become putrid, and generate a salt of this kind. This is also
true

true of the water in which some vegetables have been boiled, particularly cabbage, whose disposition to quick putrefaction is well known.

THE Copper alloy in silver does not seem to be affected by the volatile alkali. The use of silver scales therefore for weighing alkaline salts of all kinds in apothecaries shops, is extremely necessary, as they all act powerfully on Copper, and would be apt to destroy the equilibrium of the balance (a thing of great consequence in many cases) and likewise to taint other substances, that should afterwards be weighed in them.

OF neutral salts, none but nitre Neutral Salts. and common salt enter into our food, or are likely to do so without our knowledge. Glauber's salt is indeed a possible ingredient of springs, but many great chemists doubt if it has ever been actually met with. Of such then as come chiefly under the the province of the apothecary, I have nothing more to say, than to recommend great caution in the use of Copper vessels in making up any medicinal preparation in which any of them bear a part. This caution is very necessary in the making some of them which are prepared often by the apothecary, as sal diureticus, and the vegetable ammoniac, commonly
G called

called spiritus Mindereri ; as they both, the latter especially, generally contain a portion of unneutralized acid, the effects of which, in such cases, have been before mentioned.

Nitre.

As to nitre, the only use that I know it is applied to in our food, is as joined with common salt in curing meat, pork especially. As nitre itself is known to be very active in corroding Copper, and as there is reason to suspect that the neutral is decomposed, by coming into contact with the metal, and as the solvent powers of all the mineral acids are increased by heat, the utmost caution is necessary relative to the boiling meat,
thus

thus cured, in Copper vessels, as such will be almost infallibly corroded, and impart a noxious quality to the food dressed in them.

NOR is less caution necessary with Common Salt. respect to common salt, which it is well known will corrode Copper very powerfully. Several instances of the Coppers, used in the navy, being greatly corroded, by boiling the salt provisions in them, and of the bad consequences thence accruing, are related in the second volume of the Medical Observations and Enquiries. Indeed, Copper vessels are extremely improper for such uses, as being easily corroded by the muriatic

acid; and as the attraction between Copper and all the mineral acids is greatly increased by heat. Iron will answer all the purposes of Copper for such uses, and if corroded, will not be of any ill consequence to the health of those who take it in.

BRASS or Copper scales are, in my opinion, very improperly used for the weighing of salt, as is frequently done by those who retail this commodity. Most of our common salt is prepared with too great a degree of heat, which makes it apt to deliquesce, or grow moist in the air. In this case, it will infallibly corrode the Copper, and many pieces of this
poisonous

poisonous combination will probably be often rubbed off by the rough angular particles of the salt, and mixed with our food.

THE use of Copper is extremely hazardous, in my opinion, in places where the water is saline, or brackish, as is frequently the case in places lying near the sea; and as this water must, I imagine, be often used for supplying ships, it is an additional reason why Iron is preferable to Copper for making the boilers and other vessels for dressing meat in the navy.

COMMON salt will likewise affect

G 3

the

ON THE POISON

the Copper alloy in silver. I have seen silver salt-sellers, in which the salt has been incautiously left, turned blue on their inside, and in several parts blue saline efflorescences projecting from the surface of the metal. On this account therefore the use of glasses, made to fit the inside of the silver salt-sellers, are very proper, and probably prevent many accidents which might happen from the Copper being in this way mixed with our victuals.

Hepar
Sulphuris.

HEPAR sulphuris with an alkaline salt likewise corrodes Copper very plentifully. Several springs thus impregnated are drank medicinally,
and

and some others, where the impregnation is slight, are in common use, as I have seen. In the former of these cases, there is little danger of any impregnation of Copper being received into the body by their means, but in the latter it is more to be apprehended; and the greatest caution is necessary, as to Copper vessels, where any sulphureous impregnation of this kind is suspected in the water.

OILY bodies of the mild kind, though they do not themselves dissolve or corrode Copper, are very subject to impregnations of this sort. If the vessel into which they are put

Oily
Bodies.

ON THE POISON

be not perfectly clean, the oil will dissolve the rust or calces very readily, whether the corrosion was made by acids, alkalines, neutral salts, and indeed, I believe, every rust of Copper, however formed. From this we may judge of the importance of keeping all vessels wherein butter is melted and sauces made, extremely clean; and indeed it is a common observation that nothing contracts a taste from a Copper vessel sooner than melted butter, though this, I believe, is in some degree owing to the insipidity of the butter, which makes this taste more discernible, than in other dishes and sauces which have a high taste of their own. Oil likewise,

likewise, though it does not when fresh act upon Copper, yet will have this effect in a great degree when become rancid. Whether it gains this power by the volatile alkali generated in the putrefactive process, or whether by any change induced on the oil itself, I shall not determine; it is sufficient to know that in this state it becomes acrimonious, and will corrode or dissolve Copper even in its metallic state. As most of the butter we eat, for several months in the year, must have been kept a long time, it is seldom free from some degree of taint of this kind. This is an additional reason why we should avoid the use of Copper vessels as much

much as possible, in the melting of butter or other fauces containing it.

Essential
Oils.

ESSENTIAL oils, as has been before observed, act powerfully upon Copper, and I am apt to suspect, that it gets admission into the human body by their means oftner than is generally apprehended. It has been a frequent complaint of distilled waters that they often acquire a taint of Copper, which Dr. Lewis attributes to an acidulous liquour arising from many of the substances used for this purpose when the distillation is long protracted, and this I doubt not is often the case. But as essential oils
corrode

corrode Copper as well as acids, and as the herbs used in distillation abound with oil of this kind, I think we may, with great probability, suppose that the impregnation thus acquired is frequently by means of the oil which rises through the head, and trickles down its sides.

SOME of the essential oils are more corrosive than others, and this seems to be in proportion to their sensible acrimony; as I think I have observed the essential oils drawn from some of the foreign spices, as cinnamon, cloves, &c. to corrode Copper more than the oils drawn from our native aromatic herbs, but I cannot determine

mine if this rule holds universally. Perhaps it may be owing to this, in some degree, that the distilled waters of the shops are in general less agreeable than those distilled in private families, since, in the latter, Copper stills are almost entirely laid aside, and either tinned iron, block tin, or pewter, used to make the head of the still; an example which it were to be wished were practised by all who are concerned in this way of business.

ANOTHER method by which this metal is more frequently introduced into the body, is by means of brass mortars, which are almost universally
used

used for pounding spice. The bottoms of these I have often seen covered with a green or blue rust, from the substances that had been pounded in it. If this often happens, as I am confident is the case among those who are in a great way of business, the danger is evident, as the rust is almost certain to be rubbed off with the beating and rubbing of the mortar, and intimately mixed with the spice, and consequently taken in with our food, in which it is little likely to be detected, on account of the strong flavour of the substances with which it is mixed. Moreover, some things are difficult to pound, and require much beating and rubbing ;
in

ON THE POISON

in this, particles of the metal are likely to be broken off from the pestle or mortar, and mixed with the substances pounded in it.

Earthy
Salts.

Sal ca-
tharticus
amarus.

OF the earthy salts, sal catharticus amarus corrodes Copper very powerfully, especially when assisted by heat. As this salt is contained in many springs, we should be cautious as to Copper vessels, where its presence is suspected. Since this salt is prepared for medicinal use by evaporating the water of springs, such as Epsom and others, it would be proper that in such cases the use of Copper vessels should be entirely laid aside. Its being always plentifully contained in
sea

sea water, affords an additional reason for laying aside the use of Copper vessels in the navy, as the water used there is frequently brackish, from its being taken from springs in the neighbourhood of the sea.

SELENITES, which is so plentifully contained in many springs, and which imparts to them the quality which we call hardness, has much less effect in dissolving Copper: yet it is well known that spring water, by standing in Copper vessels, however clean, will in time acquire an impregnation from them, which I have often observed to be discoverable by the taste, when it was too weak to be

Selenites

be discerned by any chemical trial. But if proper care be taken, I do not think this much to be apprehended in the dressing of our food, as the vitriolic acid is dissipated soon by boiling, and before it has time to act on the metal. We might perhaps imagine that some hazard of this kind might be incurred in the use of Copper tea-kettles, which are generally made to shut close, and in such a form as not to be easily cleaned on the inside, which I believe is not often attempted. But I apprehend this is seldom the case, except the water be suffered to stand long in the cold. It is observed in general of these waters, when they are boiled in close vessels, that they incrust

crust the inside with a hard calcareous coat, which defends the metal from any further corrosion.

ALUM likewise, as an earthy salt, Alum. should be considered here, but as I have referred its effects on Copper to its decomposition, they have been before treated of, under the head of vitriolic acid.

PURE water does not, as far as I Water. can find, act upon Copper, except in consequence of some saline impregnation, or as dissolving a metallic salt already formed. Of the substances of this kind, likely to be united with water, I have before spoke, under their several heads.

H

THE

Air.

THE air likewise is well known to affect Copper. Utensils of this metal soon tarnish, and if not frequently cleaned, acquire a blue or green rust upon their surface. Whether this is owing to any saline quality, naturally adhering to the air, or any saline particles casually floating in it, is difficult to determine. I have heard that the water which came from the tops of houses covered with Copper, has proved poisonous to all the animals that drank of it. Of what kind this impregnation was, is hard to say. At first we might be apt to suppose it to be produced by the air, but as the roof of every house must be always exposed to smoak beating down upon it, which contains

contains the volatile alkali, and what is more corrosive of the Copper, to leaves of trees blown upon it, and remaining there, which would be likely to happen in country houses, we can scarce decide this point with certainty. But as we know that Copper or Brass vessels will, in all circumstances, when exposed to the air, contract a rust, which is highly pernicious if taken inwardly, we should be extremely cautious of trusting any vessel of this kind in dressing our victuals, or using for the preparation of any thing to be taken inwardly, on the presumption of its being clean, except it was cleaned very lately before the time of using, since, however so it might be when laid by,
it

it will spontaneously contract a rust, of a pernicious quality, by standing exposed to the air. This caution should be particularly attended to in brewing and distilling, where the vessels are only used at intervals.

I HAVE thus finished what I have to say on the present subject. That the work is very incomplete, I readily acknowledge, but as it contains several important cautions, relative to the health of mankind in general, which have not, to my knowledge, before appeared, in our language at least, I flatter myself it will not prove entirely useless to the public.

F I N I S.

